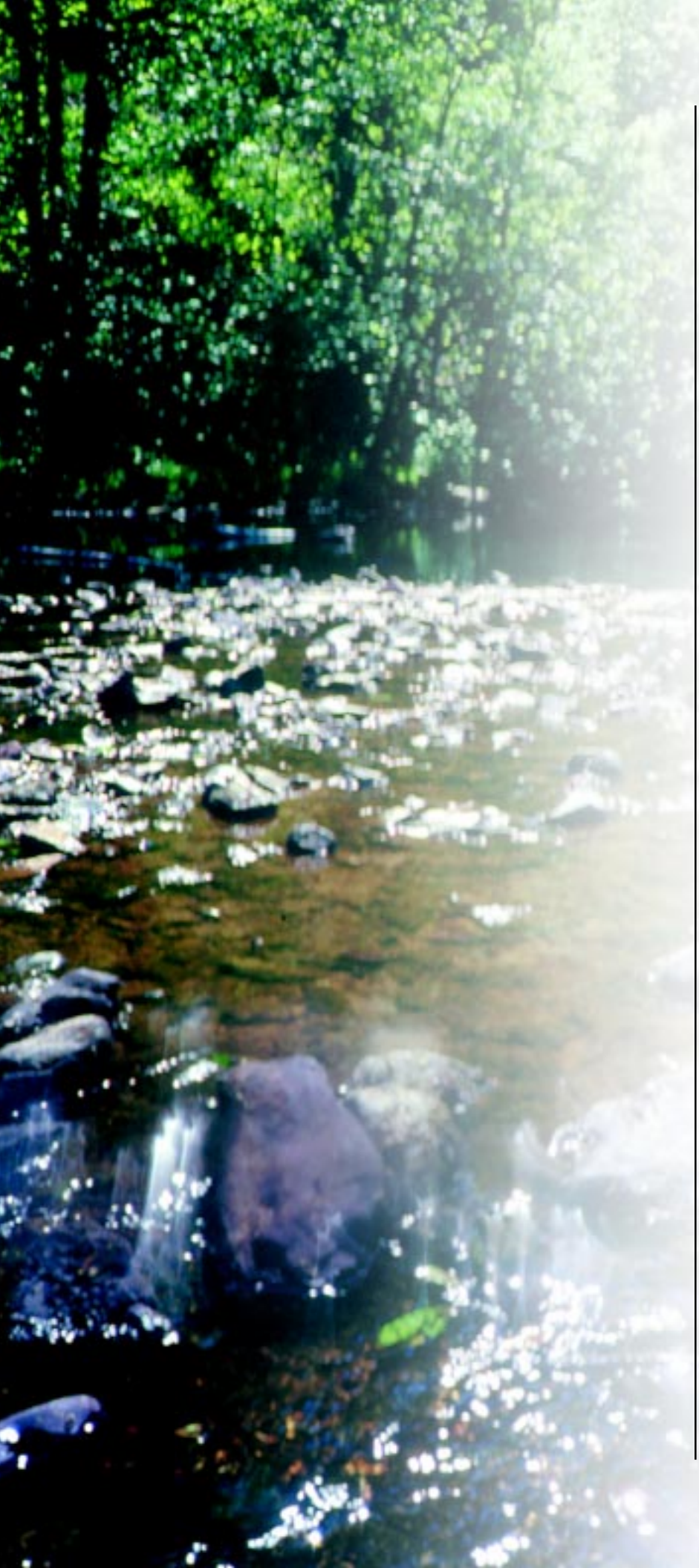

MAKING ENVIRONMENTAL POLICY ANALYSIS RELEVANT: THE EPA CASE

A Report on a Workshop
Sponsored by the
U.S. Environmental Protection Agency,
The Ohio State University, and
Michigan State University

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Edited by Laila Racevskis
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The Ohio State University

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Workshop Introduction

Larry Libby
Workshop Co-Chair
C. William Swank Professor of Rural-Urban Policy
The Ohio State University

This is the first of five annual workshops on the general theme of agro-environmental policy issues in the Great Lakes region. The series is sponsored by the U.S. Environmental Protection Agency (USEPA) with a program grant, Michigan State University, The Ohio State University, the Elton R. Smith Program in Food and Agricultural Policy at Michigan State, and the C. William Swank Program in Rural-Urban Policy at Ohio State. Planning committee members for this first workshop, listed on page 2, bring expertise from state natural resource agencies in Michigan and Ohio, federal resource agencies, academic research and education.

Our concern at this session is the relationship, if any, between academic research and environmental policymaking. Geographic focus is the Great Lakes region, though insights could apply anywhere environmental policy is being made or implemented. We know that university researchers in many disciplines and institutions are conducting meaningful and scientifically sound research on important problems. We also know that agency professionals seek effective and transparent policy, grounded in sound science. The problem, we feel, is that the communication links between researcher and agency are primitive at best. The researcher pays too little attention to the information needs of real policy, while the environmental policy administrator has little contact with the university professionals who are setting research priorities, conducting studies, and reporting results. The two sets of professionals need each other, but don't seem to know it. At a minimum, both parties and the policy process would benefit from greater interaction. Many researchers seem to regard real policy as a lower form of human activity; they have little understanding of how policy is made. Agency administrators often are impatient with the context of academic work and consider academics somewhat out of touch with "the real world." There are exceptions, of course. Some academics go on to be effective participants in real policy, while some agency administrators return to productive and useful academic careers. Our hope is that the two worlds can overlap a bit more, or at least better understand each other. We have little expectation of solving this dilemma in the next two days, but perhaps we can sharpen understanding of the issues and improve the quality of agency-researcher communication in this region.

There may be several reasons for the perceptual disconnect between research and policy. Science seeks answers to carefully defined questions. That is the legendary search for truth about the human condition. Once truth is defined, the scientist is prepared to share that insight with the world, take some credit for the effort, and move on. He or she sees no reason why that truth, with its elegant logic, and proofs does not immediately affect decisions.

The policy professional, on the other hand, knows that policy changes come in small increments, not huge leaps. That is because real people differ in their understanding of truth and, more importantly, any policy change implies a redistribution of rights and responsibilities in ways that a person or group so affected may find distasteful. The group helped by a particular redistribution of opportunity proclaims the science sound and the

policy change in “the public interest.” Those for whom the policy change would require sacrifice question the wisdom of the policy and the science on which it was allegedly based. The policymaker is caught in the middle and the researcher is seen pouting in the faculty club.

Major policy revolutions that make too many people mad are not likely to succeed, at least in a democratic system, despite the inherent logic in the position and quality of the related science. In some sense, then, good policy is acceptable policy. Political scientist Charles Lindblom coined the phrase “successive limited comparison” to describe the policy process that inevitably evolves around any particular issue. Thus, it seems that the process of science and process of policy are sometimes on different planets. Real change comes in negotiation among different versions of truth and the public interest. Researchers need to better understand what drives environmental policy and the role that science *can* play. Good science is always important and policy built on solid empirical evidence of how natural resource and human systems behave has a far better chance of success.

The workshop format is as follows:

Two workshop keynoters have been invited to offer their perspectives on the academia/policy interface. First, Len Shabman from Virginia Tech University will draw on his many years of experience as an academic economist working with federal and state water resource agencies. Len is Professor of Agricultural Economics and Director of the Virginia Water Resource Center at Virginia Tech. He has helped conceptualize and design various policy initiatives, from wetland trading systems to the large-scale water projects of the Corps of Engineers. He has some unique ideas on what this process is really all about.

The second keynoter is Tracy Mehan, Director of the Michigan Office of the Great Lakes, Department of Environmental Quality. He is an attorney, with a very pragmatic perspective on getting things done in policy agencies. He is “on the line,” struggling to meet deadlines and carry out the statutory mandates applicable to Lake Michigan. His insights on incorporating academic research, and researchers, consistent with those policy realities are what this workshop is all about.

There will be a discussant for each keynoter, academic research hydrologist David Baker from Heidelberg College, Ohio, commenting on the Mehan observations and Ohio Sea Grant Director Jeff Reutter responding to Shabman’s ideas.

Bill Cooper, a long-time academic participant in the environmental policy wars in Michigan, and around the country, will offer his ideas on this whole set of issues as the evening banquet speaker.

The final session will present three cases of integrating academic research with environmental policy:

- Jan Miller with the Great Lakes and Ohio River Division of the U.S. Army Corps of Engineers will discuss the Toledo Harbor dredging project.

- Victor Bierman, Associate Vice President of Limno-Tech, Inc., in Ann Arbor, Michigan, will report on his extensive experience with the recent national study of hypoxia impacts on the Gulf of Mexico.

- Judy Beck will discuss the fishery advisory process from her perspective as Lake Michigan Team Manager with USEPA.

Larry Libby will chair the wrap-up session at which Sandra Batie and Percy Magee from the workshop planning committee will join senior resource economist Fred Hitzhusen from the Ohio State University in offering conclusions and suggestions for any future steps. Discussion with and among all participants will be encouraged throughout the two days.

(Speakers did not prepare final papers. This workshop report presents the major points developed by each speaker and summarizes points offered from the floor.)

KEYNOTE SPEAKERS AND DISCUSSANTS

Welcome

Bobby D. Moser
Vice President for Agricultural Administration and Dean
College of Food, Agricultural, and Environmental Sciences
The Ohio State University

I am pleased to welcome all participants to this important conference on the links between science and environmental policy in this region. Ohio is an ideal location for such a workshop—we are a key portal of the Great Lakes ecosystem, and in many ways are a microcosm of the many agro-environmental issues throughout the region. Food and agriculture form the number one industry in Ohio, a $70 billion sector. Ohio is the 35th largest state in size and sixth largest in population with over 11 million residents. Ohio is both an urban and an agricultural state. Because of these characteristics, friction between rural and urban interests is manifested in many ways, including competing land use, urban encroachment, livestock odors, waste disposal, and clean water issues.

The Ohio State University's College of Food, Agricultural, and Environmental Sciences has adopted an integrated systems approach to these problems symbolized by a four-sided pyramid (see Appendix A). The sides of the pyramid are: production efficiency, environmental compatibility, economic viability, and social responsibility. Recognizing the important relationships among these factors and achieving a balance between them is important in approaches to solving problems at the rural-urban interface. The College is using this pyramid, an ecological food systems approach, to change the way it does business. As we embark on research, teaching, and extension, we now ask ourselves four questions: Is it economically viable? Is it environmentally sound? Will society accept it? Is it efficiently productive? We feel that Ohio's quality of life depends on the understanding of these relationships.

Making Environmental Policy Analysis Relevant: A Researcher's Perspective

Leonard Shabman
Professor of Agricultural Economics and Director of the Virginia Water Resource Center
Virginia Tech University

Leonard Shabman made three central points:

1. Understanding the complexities of the policy process will be necessary in understanding the contribution of academics to policymaking;
2. Not all researchers aspire to produce policy-relevant work;
3. Rather than seeking insight on policy alternatives from academic research, users of the research may be seeking affirmation of pre-selected policy alternatives.

Academics best contribute to environmental policymaking by being part of an ongoing "policy conversation," as opposed to only offering the results from a "computational algorithm," such as benefit-cost analysis. Academics who wish to participate in policymaking need to understand the rhetorical nature of the environmental policy process, as participants bring their judgments, attitudes, and values to bear on the policy discussion. Viewing environmental policymaking as a conversation among academics and those with a stake in decisions describes a decision making process that maintains a place for analytical objectivity in the process. Analytical objectivity is characterized as an openness to new data and arguments and a commitment to openly describing the models, data, and assumptions that led to a particular analytical result.

Three types of academics can be described but only two are inclined to engage in the policy conversation.

1. **Closet Scientists** *won't* become involved in the policy conversation. They have no interest in influencing policy outcomes and expect users of research to search out and interpret the literature without assistance from the academic community.

2. **Arms-Length Scientists** willingly explain research results for agencies or stakeholders, and will conduct studies of interest to policy participants, perhaps in return for financial support for their research program. These scientists are concerned for the way in which their research is used by those in the policy process, but are reluctant to become part of that process to assure the use and proper interpretation of their results.

3. **Advocacy Scientists** remain true to their professional objectivity as the work is conducted, and then actively participate in the policy conversation in an effort to create the demand for their work. Advocacy scientists wish that their work will redirect the policy conversation toward consideration of new alternatives. However, they may find that their work is only accepted by those whose positions in the policy conversation are supported by the researchers' results.

Participation in the policy conversation can become frustrating when policy advice appears to be ignored. This frustration increases when recognition for their work is not offered by either their professional peers or by the agencies and stakeholders. This frustration can tempt the arms-length, and even the advocacy scientist, to retreat into the world of the "closet scientist."

Discussion Points from the Floor

- Additional problems between academics and policymaking include insufficient resources and time provided to researchers, as well as the lack of understanding by agencies of the financial demands in academics, i.e., funding for students, the timing of thesis research.

- The transition from closet scientist to advocacy scientist can be the result of a professional evolution, i.e., it is not possible to become an active policy advocate before one is established in the academic field. It may be a career phase.

- Education is a critical part of the process and it is important to expose students to diverse academic and policy perspectives.

- There is a current trend of agencies using consulting firms and think tanks more than academic institutions because of the rapid turnaround time provided by these organizations, and this trend is not likely to change soon.

- To make research more useful for policy, agencies need to recognize the individuality of academicians, and academicians need to exhibit greater respect for the policy process.

Response to the Researcher Perspective

Jeffrey M. Reutter
Director, Ohio Sea Grant College Program and Stone Laboratory
The Ohio State University

Whether we are academic scientists or resource managers within agencies, Dr. Leonard Shabman's excellent presentation made all of us reevaluate our own positions and views. Certainly we all have heard academia referred to as "the ivory tower," and have heard non-academics refer to academic research as naïve or irrelevant. However, academic researchers and resource managers share a common background as both were created in academia. Those who chose to stay in academia consciously chose the academic world over the world of policy and bureaucracy, and vice versa. As Dr. Shabman stated, "Policy relevance is not a universal goal of all researchers."

Dr. Shabman's characterization and classification of academic scientists into four broad personality types based on their interests in research and policy was particularly insightful and revealing. It recognizes that academic scientists were not created equal and do not have the same goals and aspirations.

Dr. Shabman's Four Personality Traits:

- Closet Scientist—No interest in policy
- Arms-Length Scientist—Educate and inform
- Advocacy Scientist—Environmental advocate
- Client Advocate—Loss of professional credibility

With the possible exception of the "Client Advocate," all of these scientists can prosper in academia. We must recognize and accept this fact. Resource managers and the general public must also recognize that all academic research does not need to be policy-relevant. They might be surprised to learn that in academia, those participating in policy-relevant work may be criticized by their peers. Furthermore, not all colleges and universities are "land grant" schools with a mission for their scientists that includes research, education, and service/outreach.

Within academia we must do a better job of creating and rewarding interdisciplinary programs and projects that allow the cross cutting need to address real world problems. Dr. Shabman stated, "The disconnect of academic inquiry from practical application happens when academic researchers simplify the institutional context so that the academic inquiry can divide questions by disciplinary interest and provide answers within these professional perspectives." Others have said, "Society has problems and universities have departments." We must not allow our internal university structure to inhibit the ability of our faculty to address real world problems.

Resource managers must recognize that research takes time, and as a result, we must be sure expectations are appropriate. However, it may be even more important for academic scientists to recognize that to have an impact on policy, their research must be timely, and their results must be communicated in a way that is understandable to non-scientists. Ultimately, academics will always want to seek more information, and policymakers will always have to act without enough information.

Academic research scientists must be unbiased in their design of research projects and in their interpretation of the results. Resource managers must be equally accepting of these results. Sometimes managers are really seeking affirmations for their prior and well-thought-out positions. In this case, an academic scientist's results will be received more favorably when they support those positions.

Academic scientists must recognize and accept that their recommendations will not always be followed. Dr. Shabman cited Jack Ward Thomas, former Forest Service Director, when he said, "Researchers present results as if they were handed down from the heavens on inscribed tablets—the best scientific alternative is the only one. In reality science is just one factor in conservation decisions; it's up to the politicians and the decisionmakers to weigh the costs and benefits."

It is too often the case that academic scientists develop a proposal and then search for a buy-in for the project from an agency. The most successful interactions between academics and policymakers occur when managers are involved in the development of the projects. I was the U.S. Co-Chair of the Lake Erie Task Force for the International Joint Commission (U.S. State Department). I believe the success of the Task Force and our ecosystem modeling efforts were direct results of academic scientists collaborating with resource managers from the beginning of the process to the end.

In closing, we should briefly mention the need for academic scientists to make their opinions known to our policymakers in Washington. In this regard, quotes from a Senator and Congressman seem appropriate.

Keep in touch with the real world.

> "I don't even want to speak to you (university scientist) unless you can show me that you have spoken to a rotary club (or something similar) first."
>
> *—U.S. Senator Russ Feingold, Wisconsin*

> "In my 22 years in Congress, the only visits from scientists I've ever had are these two visits from Sigma Xi. You should do this all over the country."
>
> *—Congressman Dale Kildee, Michigan*

Making University Research More Useful for Resource Policy: A User's Perspective

G. Tracy Mehan, III
Director, Office of the Great Lakes
Michigan Department of Environmental Quality

These remarks present just one perspective on making environmental policy analysis relevant: that of a state official in an environmental, regulatory agency. This perspective will, inevitably, differ from that of a federal official or a resource manager primarily concerned with fish, forestry, and wildlife under state stewardship. The Michigan Office of the Great Lakes does try to take an ecosystem approach to the Great Lakes, one that comprehends the physical and biological components of the system, not just the chemical.

The primary focus of a regulatory agency, as opposed to a resource management agency, is determined by statutory enactments of federal and state legislatures. Such an agency cannot automatically do the ideal thing, either scientifically or economically, without often exceeding, or at least severely stretching, its authority under law. You do not see the kind of broad constitutional mandates granted to natural resources agencies, usually under the supervision of an independent commission.

Another consequence of the statutory nature of regulatory mandates is the rather narrow, functional nature of the immediate needs and preoccupations of a regulator. "Don't distract me with the 'big picture.' I need to get rules promulgated, permits reviewed and issued, inspections done and enforcement carried out—on a very small budget," says the harried regulator with very few friends in the regulated and environmental communities or the legislature. If you don't have resources to carry out your basic statutory mandates, it is hard to stop and scan the horizon for the next big issue, looming challenge, or break-through technology.

Standards of Performance

In 1990, Marc Landy, Marc Roberts, and Stephen Thomas, scholars at Boston College, Harvard College, and The Commonwealth Fund, respectively, authored a provocative book entitled *The Environmental Protection Agency: Asking the Wrong Questions* (Oxford University Press). In an insightful introduction, the authors outlined four (4) standards by which to judge the performance of the agency which are of general applicability to most governmental institutions. These standards also serve to highlight the essential role of policy analysis and research in carrying out the core, strategic functions of a public agency.

The standards are as follows:

- *Fidelity to technical merits*—relating primarily to academic and public discourse;
- *Promoting civic education*—responsibility of government to improve citizens' capacity for self government;
- *Responsiveness to the public*—demonstrate accountability;
- *Building institutional capacity*—success here depends on success with the first three.

Two case studies will illustrate violations of these standards by public agencies as well as researchers.

The first case study concerns an EPA proposal from 1993 entitled The Great Lakes Water Quality Initiative Guidance, or GLI. The GLI was an ambitious, new regulatory proposal, addressing persistent, bioaccumulative toxics under the Clean Water Act and the Great Lakes Water Quality Agreement between the United States and Canada. The rule promulgated by EPA was 308 pages in length. The process of estimating the benefits and costs of this study generated an extremely wide range of cost estimates, from $80 million to over $10 billion. No known academic studies were conducted on the subject, and therefore no source of disinterested economic research was available for analysis of this public policy decision.

The second case study focuses on the proliferation of "aquatic nuisance species" that have been introduced into the Great Lakes through ballast water from international shipping. The invasion of these exotic species is posing a substantial threat to biodiversity in the Great Lakes. Academic research on this subject has focused on the effects of existing introduced species and not on prevention of the introduction of more exotic species. A 1997 study by the Great Lakes Panel on Aquatic Nuisance Species established that only four percent of the total research expenditures on exotics in the Great Lakes could be categorized under the heading "Prevention of Introduction." This is a real world example of a case where academic research has not provided the necessary tools for policymakers to implement appropriate and effective strategies to prevent further introduction of exotic species into the Great Lakes.

Policy work must be timely, accessible for non-experts, and must be targeted to both legislative and executive branches of government. From the regulatory agency standpoint, academics are lagging behind the think tanks in terms of their capacity to provide timely research. There is a strong need for disinterested research in the policy arena, and one of the most important tasks ahead is to eliminate the gulf between scientists and non-scientists.

Key Points from Discussion

- The policymaking system is currently deprived of disinterested economic analysis, for which there is a strong need. There seem to be few economists willing to focus on policy questions, for reasons discussed above; and few working directly for environmental agencies.

- Technical advice is not widely available in the policy arena, and there needs to be a network of economists who can be part of the process. A panel of academic economists, available to review proposals or implement procedures, would be very useful.

- Economic arguments for environmental policy have prevailed over time and will continue to prevail. The economic consequences of an environmental problem can be a powerful instigator, and the economic implications of various ways to solve or mitigate those problems are the substance of environmental debates.

An Environmental Scientist's Reflections on the 'User Perspective'

David B. Baker
Professor, Heidelberg College

The discussant paper addresses five points made by Tracy Mehan.

1. **Fidelity to technical merits—**
   The academic scientist plays a very important role in disseminating objective scientific information to policymakers. In conveying their messages to policymakers and the public, advocacy groups often filter out information that does not support their position. It is the responsibility of scientists, therefore, to educate the public on the scientific issues that influence policy decisions.

2. **Policy work must be timely in terms of delivery—**
   Academic research could influence policy more effectively if research were made available to legislators and policymakers in a timely manner. This is difficult for academics, however, because of the many demands of the profession as well as time-consuming research methods. It may be more important for the researcher to provide agencies with current research results that are incomplete than to wait for complete results, by which time they may be outdated for policymaking.

3. **Policy work must be accessible for non-experts—**
   It is important for academic researchers to convey complex information quickly, efficiently, and clearly. To increase their effectiveness in policymaking, academic scientists must be able to explain a complex issue during a short conversation in the hallway of the capitol building or to convey an understanding of scientific information in a two-page briefing paper. Hopefully agencies will increase opportunities to interact with scientific researchers on important policy issues. Scientists can participate in the policymaking arena through participation in such areas as technical and scientific advisory groups and open hearings concerning rulemaking and regulation.

4. **Policy work must be targeted to both the legislative and executive branch, as dictated by the circumstances—**
   The basic message of the issue being conveyed by the scientists to the policymakers should be consistent in order to avoid loss of credibility. However, the delivery of the message should be tailored to the recipient in a manner that conveys an understanding of the scientific issues in the best way.

5. **Most academic researchers attempt to adapt an agency's grant program to their own research agenda, rather than *vice versa*—**
   Through grant writing, scientists are automatically in a position to advocate the work they can do for the agency and its relevance to the agency's needs. Submitted proposals that stray from agency guidelines are likely to be rejected. This presents a dilemma for the researcher who feels that the agency is asking the wrong questions or excluding effective approaches to the research problem. While contributions to the development of agency grant programs by academic researchers could resolve this dilemma, a new set of ethical issues would be generated from this new role for researchers.

In the April 2000 issue of *CSA News* (Crop Science—Soil Science—Agronomy News), an article on this topic quotes the response of Representative George E. Brown of California to the following question: "How skilled are scientists at presenting their cases to Congress?" His response: "Very unskilled. They, generally speaking, have great faith in the power of common sense and reason." Dr. Neysa Call served as a CSA congressional Science Fellow in the Office of Representative Brown. In response to Representative Brown's quote, she said:

"This is true. There is little rationality in the political process. I've learned firsthand, what for years Rep. Brown tried to instill in the scientific community. If you are going to interact in a political environment, you have to know the reasoning and context of the people you are dealing with. Different stakeholders are driven by different perspectives. For example, a scientist and a politician are usually not motivated by the same circumstances or for the same reasons."

The challenge of increasing the effectiveness of interactions between academic researchers and policymakers is significant. It is important to get the messages from the scientific community through the political filters that surround agencies.

Key Points from Panel Discussion

(Shabman, Reutter, Mehan, Baker)

- It is possible for scientists to be effective agency administrators—some have. Likelihood of success varies significantly among the disciplines, as some are just not geared to decision-making or to the policy process. Some disciplines insist on single-valued definitions of "truth," that just don't fit the give and take of policy.

- The concern that there is nobody to speak for "good science" was raised. There are different schools of science, and it is impossible to escape the messy public debate that surrounds issues. Therefore, it is up to scientists to speak up for themselves. The notion of platonic science has been cut away in the philosophy of science and agencies are left in a position to sit back and watch the "battle of the PhDs."

- The disconnect between science and policy exists on both the academic and policy sides and has become a politically polarized game. However, agencies themselves seek out "good science" and can therefore help ensure it. Because politics will inevitably enter into searches for government money, researchers need to demonstrate courage.

- We have created the impression that science can tell us only one answer. We need to teach the process of science and remove the assumption of right versus wrong, thereby creating a better understanding of the scientific process.

Making academic research more useful for policymaking will involve long-term disinterested interaction and trust building among scientists and policymakers.

CASE STUDIES OF EFFECTIVE RESEARCH/POLICY INTERACTIONS

Toledo Harbor Dredging

Jan Miller
U.S. Army Corps of Engineers
Great Lakes and Ohio River Division

This case study examines the flow between research and policy that relates to dredging activity in the Great Lakes, and specifically in Toledo Harbor. There are numerous policy vehicles that relate to dredging:

- Clean Water Act
- Superfund/SARA
- Toxic Substance Control Act (TSCA)
- Resource Conservation and Recovery Act (RCRA)
- Water Resources Development Act (WRDA)
- Appropriations Acts (various)

Policy Issues

Limited funding has become a principal policy concern because many factors have forced the costs of dredging to increase. Among those policy concerns are funding of sediment remediation through enforcement actions, increasing dredging and disposal costs, and the preference of dredging commercial harbors over recreational harbors.

Another important policy concern is the presence of more restrictive environmental laws. New water quality standards have been established in response to the Great Lakes Initiative (GLI). There has been a reluctance by states to provide a mixing zone for the disposal of dredged material. Environmental laws have also been influenced by the rulemaking of the Toxic Substance Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA).

Public perceptions of open water disposal of dredged material are driving state policies while federal law allows open water disposal where tests have shown acceptable impacts. Therefore, state policies are in conflict with federal interests regarding open water disposal of dredged material.

The federally funded confined disposal facilities (CDFs) are reaching capacity levels. The Water Resources Development Act of 1996 requires cost sharing of any new CDFs. However, there are few cities and ports that have the capability to cost share these new facilities.

Research Objectives and Programs

There are two principal categories of dredging research: equipment and disposal options. The objectives of dredging equipment research are to reduce sediment suspension, gain greater accuracy and control, and gain a higher solids content. Research about disposal options involves the search for better and cheaper evaluation tools and alternatives to CDFs while also finding ways to extend the useful life of existing CDFs and determining cost-efficient treatment of contaminated sediments.

Dredging research programs to date have been reactive rather than proactive, and some may be accused of "reinventing the wheel." Past research includes:

- Great Lakes Pilot Program (1967–69)
- Dredged Material Research Program (1973–78)
- Field Verification Program (1982–87)
- Long-Term Effects of Dredging Operations (1982–86)
- Assessment and Remediation of Contaminated Sediments (1988–94)
- Dredging Research Program (1988–94)
- Dredging Operations and Environmental Research (1998–present)

Toledo Harbor

Over fifteen million tons of commercial cargo travel through this harbor annually, primarily coal and iron ore. The annual dredging in Toledo Harbor amounts to 850,000 cubic yards, which is almost one quarter of the total annual dredging in the Great Lakes. The sediment is composed of silty clay, which includes phosphorous and other nutrients from agricultural runoff.

The Toledo Harbor CDF is a lake fill in western Lake Erie comprising 397 acres. The first cell was constructed in 1974 and the second in 1994. More than half of what is dredged

from the Federal channel is suitable for open water disposal, according to testing criteria. There are some state and local interests that want to phase out open water disposal. If all dredged material is confined, the capacity of the existing CDF is less than ten years. Presently there is no market for upland use of the dredged material.

Research and development studies for Toledo have evaluated open water disposal impacts through phosphorous bioavailability, sediment transport modeling, bioassays, and bioaccumulation. Manufactured soils such as mixtures of dredged material, sawdust, and biosolids have been developed through cooperation with commercial companies and tested through plant growth studies and pilot demonstrations. There have also been soil conservation demonstrations in cooperation with the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture to illustrate incentives for no-till farming in the Maumee watershed.

The research has generated positive results in policymaking. The bioassay procedures have been incorporated into the regional testing manual. State policy has been developed on the environmental regulation of the upland beneficial use of dredged material, however, subsidy and liability issues surrounding beneficial use remain unresolved. The soil conservation benefits to navigation have been documented, but there is no funding mechanism in place.

Currently, the navigation needs for dredging are much higher because lake levels are low. In addition, there are a number of sediment remediation projects poised for action. The principal research needs now are developing more cost efficient beneficial uses of dredged material for navigation dredging and understanding the environmental acceptability of “natural recovery” as an alternative for sediment remediation. The principal policy needs include more consistent regulation of beneficial use and upland disposal, a mechanism for funding soil conservation based on its benefits to navigation, and guidance on how to implement “natural recovery” as a sediment remediation alternative.

Thus research does make a difference in dredging policy and will continue to be important in the future. The real challenge is to link effectively to the research establishment with Request for Proposals consistent with the information needs.

Hypoxia in the Gulf

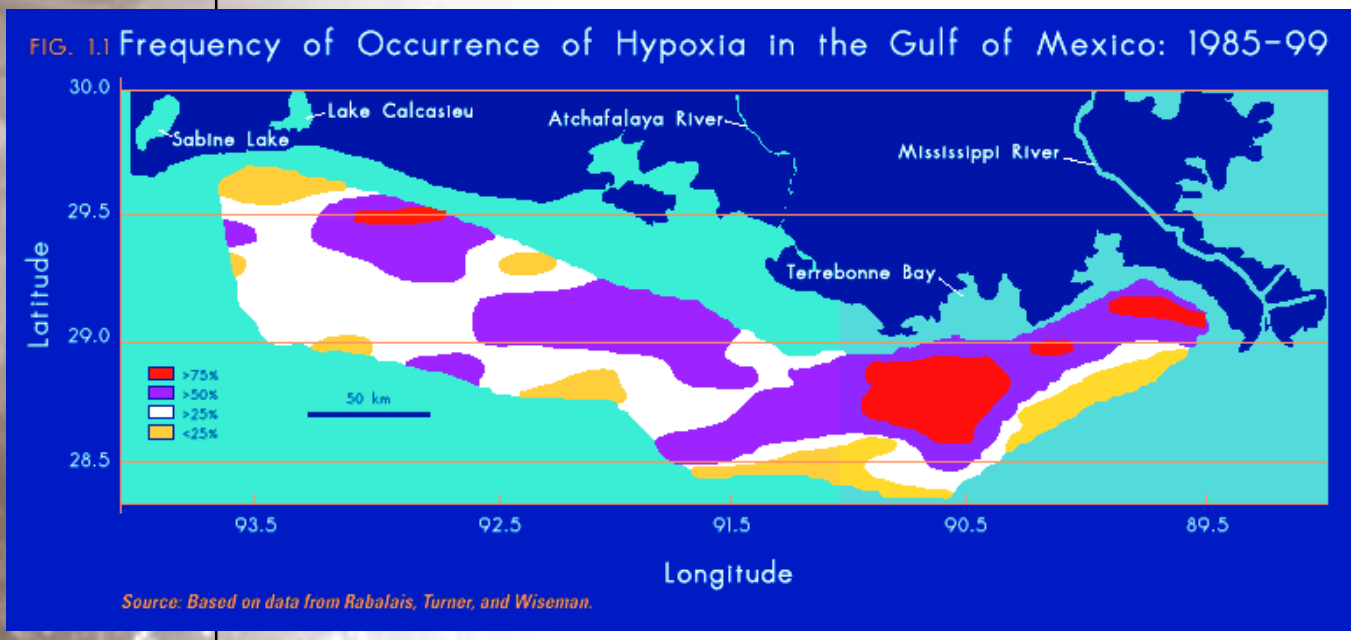
Victor J. Bierman, Jr.
Associate Vice President, Limno-Tech, Inc.

Background

The largest zone of oxygen-depleted coastal waters, or hypoxia, in the United States and the entire western Atlantic Ocean exists in the Gulf of Mexico in the bottom-waters of the Louisiana/Texas continental shelf. The area affected by hypoxic conditions is about the size of the state of New Jersey. The National Science and Technology Council's Committee on Environment and Natural Resources (CENR) convened a task force on Harmful Algal Blooms and Hypoxia in 1997. An assessment plan was developed in conjunction with the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (MR/GM Task Force) and approved in 1998. In October 1998, Congress passed the Harmful Algal Bloom and Hypoxia Research and Control Act, which was signed into law as P.L.105-383 by the President on November 13, 1998. This law calls for an integrated assessment of hypoxia in the northern Gulf of Mexico that examines:

1. the distribution, dynamics, and causes of hypoxia;
2. ecological and economic consequences;
3. sources and loads of nutrients transported by the Mississippi River to the Gulf of Mexico;
4. effects of reducing nutrient loads;
5. methods for reducing nutrient loads; and
6. the social and economic benefits of such methods.

A Hypoxia Working Group was convened and six assessment teams were formed, made up of experts within and outside of government, to address each of the above listed concerns. The teams were not established to conduct new research, but rather to review and analyze existing data and apply existing models of the watershed-Gulf system.



The assessment process consisted of the following eight steps:

1. Science teams produce reports;
2. Independent peer review;
3. Open for general comment;
4. Integration team synthesizes report into integrated assessment;
5. External review and public comment;
6. Public meeting and stakeholder input;
7. CENR review; and
8. Final integrated assessment and stakeholder input to task force.

In addition to this assessment, P.L. 105-383 calls for the development of a plan of action to reduce, mitigate, and control hypoxia in the northern Gulf of Mexico. This assessment is intended to provide scientific information as a basis for the Action Plan but is not intended to make recommendations for action nor is it the only source of information which will be used in developing the Action Plan.

Assessment Results

Hypoxia occurs in the bottom of the water column near the sediment/water interface and is the condition in which dissolved oxygen levels are below those necessary to sustain most animal life (less than 2 mg/l). The extent of the mid-summer, bottom-water hypoxic zone in the Louisiana/Texas continental shelf varies, but has increased since regular measurements began in 1985. Since 1993, it has been larger than 10,000 square kilometers (about 4,000 square miles). The largest hypoxic zone measured to date was in 1999; 20,000 square kilometers.

Hypoxia has significant ecological impacts, causing an overall reduction in biodiversity, abundance of species, and biomass. These ecological impacts, in turn, may cause economic impacts as measured by decreased biomass of fish and shrimp catches. The fishing industry has shifted shrimping efforts away from the hypoxic zones. Brown shrimp catch, the most economically important commercial fishery in the Gulf, declined from a record high in 1990 to below average during the years 1992–1997, coinciding with years of greatly increased hypoxia. Even so, the economic analysis of fisheries catch data did not demonstrate statistically significant effects attributable to hypoxia.

Hypoxia occurs when the rate of oxygen consumption exceeds the rate of oxygen production and replenishment. Decomposition of organic material consumes oxygen. Organic material is supplied from external sources or produced within the system by phytoplankton production. Nutrients delivered to the system fuel phytoplankton production. Fecal pellets from grazing zooplankton and dead phytoplankton cells sink to the bottom waters. In the bottom waters the decomposition of the organic material occurs, consuming oxygen. Stratification of the water column prevents the cooler and dense bottom waters from mixing with the warmer, and frequently fresher surface water. Minimal mixing of the water column prevents oxygen replenishment in the bottom waters. At dissolved oxygen levels less than 2 mg/l, mobile organisms leave and remaining organisms die off at varying rates, depending on how low the oxygen levels get and for how long they remain depressed.

The extent and severity of hypoxic conditions in the Gulf of Mexico depend on climatic conditions and the amount of nutrients delivered. One cause of hypoxia is the physical

stratification of Gulf waters, which is influenced by precipitation, temperature, and weather patterns, all outside our control. Another cause of hypoxia is the presence of excess nutrients (primarily nitrogen) from the Mississippi River Basin, potentially within our control. Nitrate loading to the Gulf from the Mississippi River tripled from 0.33 million metric tons per year during 1955–1970 to 0.95 million metric tons per year during 1980–1996. About 90 percent of the nitrate comes from non-point sources. Results of water quality modeling indicated that dissolved oxygen levels do appear to be responsive to reductions in nutrient loads from the Mississippi River. However, there are large uncertainties in the magnitudes of these responses for a given nutrient load reduction. For nitrogen load reductions of 20–30%, bottom-water dissolved oxygen concentrations were estimated to increase by 15–50%.

In order to fix hypoxia, methods for nitrogen load reduction need to be practiced. The two primary approaches to reduce nitrogen loads from the Mississippi River Basin include: reducing inputs of nitrogen to streams and rivers in the Basin; and restoring and enhancing natural denitrification processes in the Basin. In the first category, the most effective actions include reducing application of nitrogen fertilizer. In the second category, the most effective action would be increasing the acreage of wetlands and riparian buffers within the Basin. These approaches will also produce environmental benefits within the Basin. Based on analysis and modeling of these approaches across the Basin, one illustrative approach to reduce nitrogen loads by 20% would be through a program of 20% reduction in fertilizer use, and 5 million acres of wetland construction or restoration.

Costs of these restorative practices would include changes in producer and consumer welfare from changes in production costs and commodity prices, as well as the cost of restoring wetlands. The benefits in the watershed need to be considered and would include habitat restoration and reductions in soil erosion.

Research-Policy Relationship

The role of research in this project focused on analyses of existing databases. Long-term monitoring data were very important in the characterization of hypoxia and in determining nutrient loadings to the Gulf. It was important to understand causal relationships in the data throughout the Mississippi Basin.

Success was achieved by maintaining visibility with funding agencies and legislators through communication and public outreach. The research also successfully drove the issues, alternatives, and potential consequences. Linkages within the Mississippi River Basin and the Louisiana Inner Shelf were developed at large spatial scales, a major research accomplishment.

Analyzing this large problem within a short time frame with limited resources presented a major area of frustration in the research. The issue was highly polarized among scientists. Other frustrations included preconceptions and misconceptions as well as the inability to link hypoxia to fisheries impacts.

The research may have been more successful if there had been more of a focus on hypoxia as an issue. Less reluctance by agencies to fund long-term monitoring also could have made the research more useful. Collaboration among government agencies, academics, and stakeholders should have occurred earlier. Research results were disseminated too early, before battle lines were drawn, and were therefore incorporated into the debate. There was an unfortunate polarization among the scientists involved. For example, agri-

culture at first doubted the existence of water quality issues at all. Faced with the evidence, agriculture acknowledged a problem but denied that farms were causing it. The debates continue, as they always will. Science and timely research can at least sharpen the terms of discussion, reducing some of the mystery surrounding the issue.

Policy is driven by social, political, and economic factors, not just science. Collaboration among government agencies, academics, and stakeholders is essential. Research should be viewed as part of an overall management framework. A comprehensive, carefully targeted program of monitoring, modeling, and research to facilitate continual improvement in scientific knowledge and adjustments in management practices should be coupled to whatever initial nutrient management strategies are chosen. This adaptive management scheme involves continual feedback between interpretations of new information and improved management actions.

Challenging questions that policy-makers face in using research include:

- When are the research results "good enough" for decision-making?
- How is understanding of the current situation balanced with the need to forecast future behavior?
- How should policy handle uncertainties in research results?
- How are costs and benefits evaluated in ecological systems?

For more information on hypoxia and the Gulf of Mexico, visit the following web sites:

U.S.EPA at **www.epa.gov/msbasin/issue.html**
NOAA at **www.nos.noaa.gov/products/pubs_hypox.html**
USGS at **wwwrcolka.cr.usgs.gov/midconherb/hypoxia.html**
Council for Agricultural Science and Technology (CAST) at
www.cast-science.org/hypo/hypo.htm.

Fish Advisories

Judy Beck
Lake Michigan Team Manager
U.S. Environmental Protection Agency

Agencies, the academic community, and stakeholders are engaged in a three-way conversation. The academic system wants quality knowledge. There is a research team within the Lake Michigan agency, and policy for fisheries is strongly and positively influenced by research.

The EPA will be releasing a new Lake Michigan Lakewide Management Plan, or LaMP, this year. This will be both a document and a process to guide the sustainable management of Lake Michigan. It will provide an opportunity for citizens, local governments, and researchers to interact with policymakers and thus combine environmental knowledge, planning, and action.

Key Points from Panel Discussion

(Miller, Bierman, Beck)

- Adaptive management, by design, may greatly improve the situation through more strategic research that recognizes complex systems and incorporates these into management. However, research that crosses multiple agencies often does not work well because it can be time consuming and difficult. This would require commitment to long-term monitoring. Adaptive management may incorporate more uncertainty.

- In the real world there is opportunistic management; demonstrating benefits is more important than realizing them.

- There has to be a collaboration between government and researchers, and there need to be people inside government who understand the science and can work with academics. We also need academics who understand the policy process and the role of agencies in implementation.

- Re-suspension and internal nitrate loading are not as much of a problem in the Gulf as they were in Lake Erie.

- Agricultural areas that produce contaminated sediments but do not have a watershed plan should (arguably) pay for the dredging, but there is no program currently in place to accomplish this. This would be consistent with the “pollution pays” principle applied elsewhere.

- There need to be professional mechanisms to allow academics from different disciplines to work together. Institutions need to change internally to encourage more interdisciplinary work.

- Someone from academia should be involved in creating an academic coordinating council to help interested scientists participate more effectively in policy design

and implementation. Someone needs to *mobilize* available scientific expertise. Links between academic researchers and policy professionals do not happen by themselves. They take effort and resolve. Perhaps there are ways to make the work of “closet scientists” (Shabman’s term) digestible for policy.

PANEL DISCUSSION/WRAP-UP

Sandra Batie
Elton R. Smith Professor of Food and Agricultural Policy
Michigan State University

Dr. Shabman reminded us that effective environmental policymaking should be thought of as an "ongoing conversation." There are rules of engagement for this conversation which can be stated as follows:

1. **Develop Relationships and Alliances—**
   Developing relationships and alliances requires trust, respect, and understanding among researchers and policymakers as well as patience. The patience is needed not only because building relationships takes time, but also because relationships are continually changing as individuals come and go in various positions and in their policy involvement.

2. **Find the Right People and Partners—**
   Because conversations are the heart of effective policymaking, it helps if one can find people with whom they resonate. For example, policymakers tend to view all economist researchers as similar and interchangeable—that is, all are equally skilled in the subjects. Of course, that perception is false—not only are there very different subspecialities, economists occupy all of Dr. Shabman's niches from closet scientist to client advocate.

3. **Work at the Right Level—**
   There are different levels—that is different conversations for different types of research. Some forms of policy analysis relate to the action or implementation stage, while more basic work assists in policy design or problem definition.

4. **Work on the Right Problems—**
   There are times when much of the policy conversation should be exploring the definition of the problem to which policy is oriented.

5. **Know the Context in Which You are Involved—**
   It is important to be familiar with the history of the policy of interest as well as its current context. Also, just as policymakers have constraints, so do researchers who must survive in their institutions. Their survival requirements may inhibit some relationships.

Making these linkages between academy, civic, society, and agencies is an art and a constant learning process.

Fred Hitzhusen
Professor
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1. More dialog and exchange between environmental researchers, managers, and regulators needs to be promoted. Researchers and agency types must listen to, learn from, and respect each other. It is important to understand time horizons, context, mission, and funding source. Learning these things takes time, and help is needed from university administrators to support building relationships between disciplines. There also needs to be more support of collaborative relationships between academics and agencies. Long-term relationship building takes time, and there may not be funding right away, but one can learn and the process can be challenging. For example, I worked with a group of graduate students to help the Ohio Environmental Protection Agency develop a basis for setting anti-degradation priorities and with the Ohio Department of Natural Resources in valuing services of their agency. These were excellent learning experiences for the students and hopefully useful for OEPA and ODNR.

2. The definition of "good science" needs to be broad and inclusive. It is important to apply good science to the technical physical and biological issues as well as to understanding how decisions are made. Examples of the latter include personality typing, cognitive processes, consensus building, and public choice theory. Shabman's categorization of the four types of researchers is much more appropriate than the typical false dichotomy between pro- and anti-policy scientists. Other false dichotomies include point vs. nonpoint pollution sources and government vs. market solutions.

3. It is important to recognize the variation within our own disciplines. For example, there are at least four brands of environmental economics: 1. free market, Coasian bargaining (Anderson, Avery); 2. the new institutional economics, property rights enforcement (Bromley); 3. pricing externalities and service flows in benefit cost analysis; and 4. ecological economics and sustainable development (Daly). The latter approach first defines sustainable scale, then fair distribution, and finally economic efficiency.

4. We should promote inter-agency and university task forces that can consider problems at a fairly large and interdisciplinary scale, such as the case with the hypoxia task force discussed by Bierman. Watersheds or river basins, airsheds, etc., are good integrative biophysical bases for organizing such activities.

Percy Magee
Great Lakes Water Quality Coordinator
Natural Resources Conservation Service

It is necessary to get the right people together to discuss these issues. There is often a large time lag between policymaking needs and time-consuming research. The research is often outdated by the time it is completed. There may be farmers who are willing to pay for sediment removal, but they may not be able to bear the costs. There is a need to coordinate and interact with individuals involved in agriculture.

Final Discussion Points

- Moving to an ecological perspective forces us to work in different ways to define the questions more completely and engage the necessary expertise. It is not just the substance of a question that is significant but the way in which it is phrased.

- We are all policymakers in some way. Managers and academics could cooperate in different ways, and the network of county Extension agents could be better involved to disseminate information for this purpose.

- The relationship between the academic community and the legislative arena is different from academic/agency relationships. New legislation more directly affects distribution of rights and obligations among groups and interests in society, thus direct academic involvement can be problematic. Agencies are responsible for implementing policy, not writing it, though rule-making can clearly have different effects on different people.

- The form that communications take is important. Agencies look for abstracts of research, short summaries. The different routes of communication need to be examined to determine which formats are the most widely used. There may be a disconnect in the way information is communicated between academics and agencies. Specific attention should be given to the communication process.

- There is no administrative reward system in place for rewarding the creation of organizational structures that bridge academics and agencies.

- The reality of academia is that the refereed journal article is more respected than policy analysis. That could be changed.

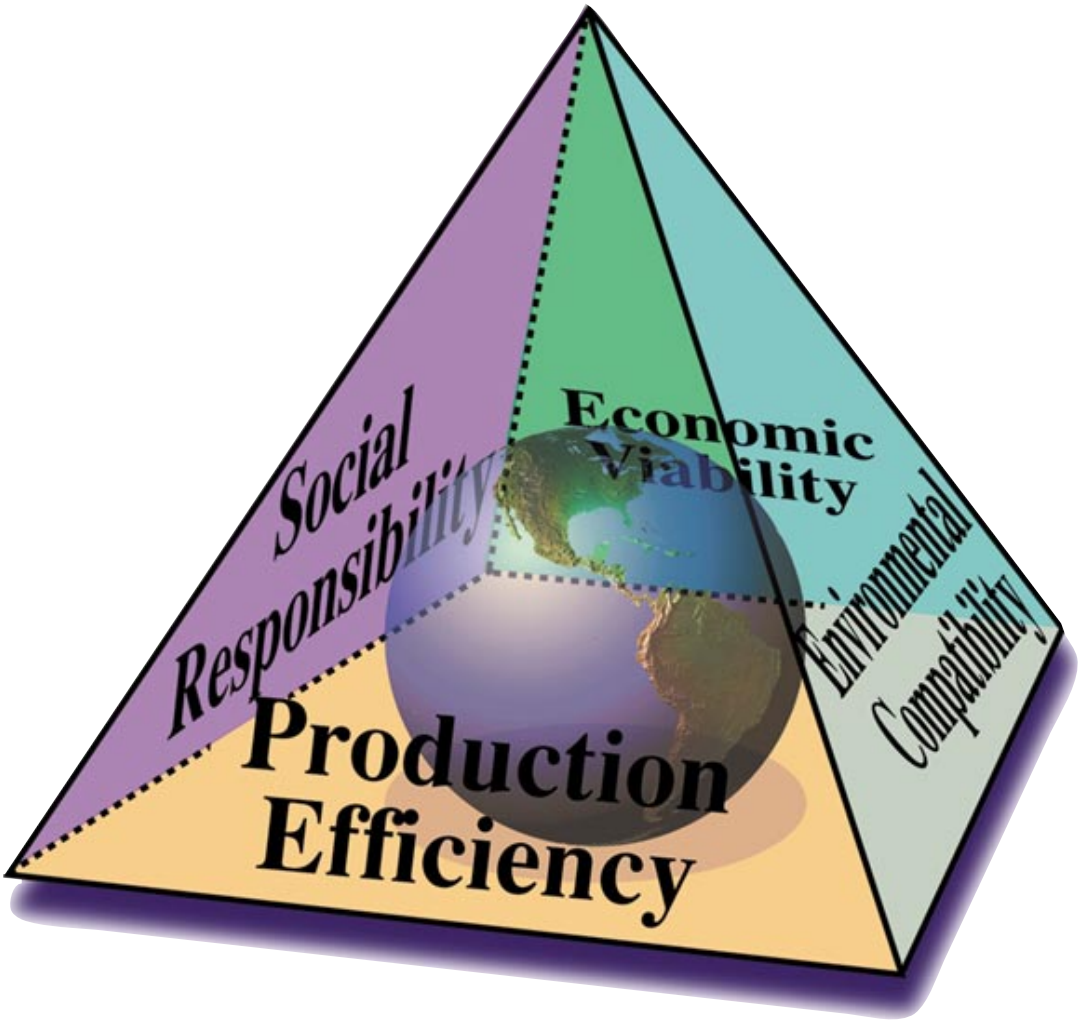
- Agro-environmental issues are dealt with at local, not just state and federal levels, and these levels of government need better connections with academics also.

- Individual scientists interested in policy need to establish continuing links to agency people. They need to know each other as collaborators, even occasionally as colleagues.

- A system of six- or twelve-month visits/sabbaticals should be set up to help the agency professionals experience academia again firsthand and give the academics a sense for the real world of policy.

APPENDIX A

The Four-Sided Pyramid



APPENDIX B

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